XLIX.—*The Sponge-fauna of Norway; a Report on the Rev. A. M. Norman's Collection of Sponges from the Norwegian Coast.* By Prof. W. J. Sollas, M.A., F.R.S.E., &c.

[Plate XVII.]

[Continued from p. 165.]

Tetilla cranium (continued).

Before proceeding to the description of the next sponge it will be necessary to add, by way of appendix, a few words on the generic designation of this species. I had indeed hoped that its title *Tetilla* was inalienably joined to it; but unfortunately that is not the case, since it is not the type of the genus. This place is occupied by *T. euplocamus*, O. S., on which, in in 1868, the genus was founded. This species, indeed, enjoys a name which cannot be changed, but not *T. cranium*; let any difference of generic importance be discovered between it and the type, and *T. cranium* must find a new generic name. The existence of such a difference has already been proclaimed by O. Schmidt, who regards the possession of anchoring filaments by *T. euplocamus*, *polyura*, *radiata*, and *submersa* as a generic character, uniting them together, to the exclusion of *T. cranium*. As a matter of course, *T. cranium* should receive a new generic name; but, as a matter of fact, the new name has been found for the type and its congeners, while the old one is retained by the residual *T. cranium*.

Whatever special advantages this plan may possess are counterbalanced by its contravention of a recognized custom, and its consequent tendency to throw our nomenclature, which is based on recognized custom, into confusion. The oftener general rules are broken the less binding do they become; and the natural result is anarchy. The taunt of being a "purist" in these matters is a reproach to glory in; for till we have the absolute despot, desired by a writer in 'Nature,' to regulate our terminology we shall do well to make the best use we can of an existing substitute; and that is loyal and implicit obedience to those few simple rules which have approved themselves to the general sense of biologists, and of which an excellent summary is given in the 'Stricklandian Code,' published under the approval of the British Association. The practical application of this moral excursus is obviously that *Tetilla euplocamus* should retain its generic name, and if a new one is necessary it should be found for *T. cranium*. But I greatly doubt the necessity; for the presence or absence of anchoring fascicles appears to me to be of scarcely specific, much less of generic, importance; indeed I have now before me a sponge which in no detail of gross or minute anatomy differs from *Thenea Wallichii* (*Wyville-Thomsonia*), except that it is entirely devoid of the usual appendages. So far as this character goes, therefore, I see no good grounds for separating *Fangophilina* from *Tetilla*, and would therefore reunite them. In that case *Tetilla* (Sollas) would comprise *Tetilla*, Sdt., *Craniella*, Sdt., and *Fangophilina*, Sdt.; but it is quite possible that the distinction between *Tetilla* and *Craniella*, asserted by Schmidt, in the absence of a rind in the former genus, does really exist, and that *T. cranium* has been wrongly included in *Tetilla*, its true place being with *Craniella*. But if *T. cranium* be taken from Schmidt's *Tetilla* there remain only in that genus *T. polyura*, *euplocamus*, and *radiata*, all of which are provided with anchoring tails. By amending the definition of the genus so as to make it include as a character the possession of "tails," all necessity for a new name will disappear, since the residual species of *Tetilla*, left after the removal of *T. cranium*, are just those which Schmidt includes in *Fangophilina*. Thus, if *Craniella* prove distinct from *Tetilla*, we have, on Schmidt's own showing,

Craniella + *T. cranium* = *Craniella*.

Tetilla − *T. cranium* = *Tetilla* = *Fangophilina*.

It only remains to include *Fangophilina submersa* in our list of *Tetilla*, and to add a species of Bowerbank which I had previously overlooked. Continuing from page 161, we have

14. *Tetilla submersa*, O. S. Spong. Meerb. Mexico, 1880, p. 73, pl. x. fig. 3. Carib. Sea.

15. *T. unca*, Bwk. P. Z. S. 1872, p. 118, pl. v. figs. 7–10. Hammerfest, 150 fms.

Tetractinellidæ, Marshall.

Externæ, Sollas.

Leptochrota, Sollas.

Thenea, Gray.

Thenea Wallichii, Perceval Wright.

Synonyms.

1870. *Whyville-Thomsonia Wallichii*, Perceval Wright.
 „ *Stelletta agariciformis*, O. Schmidt.
 „ *Dorvillia agariciformis*, Kent.

1871. *Thenea Wallichii*, P. Wright.
1872. *Tethya agariciformis*, Kent.
1873. *Tisiphonia agariciformis* (Kent), Wyville Thomson.

LITERATURE.

(i.) 1858. *Tethea muricata*, Bwk. MS. Phil. Trans. pl. xxv. f. 18.
(ii.) 1862. *Tethea muricata*, Bwk. MS. Phil. Trans. pp. 782, 793, 826, pl. xxxi. figs. 14, 15.
(iii.) 1867. *Thenea muricata*, Bwk., Gray, Proc. Zool. Soc. p. 541.
(iv.) 1869. *Tisiphonia*, n. g., W. Thomson, MS. Phil. Trans. 159, p. 712.
(v.) 1870. *Wyville-Thomsonia Wallichii*, Perceval Wright, Q. J. Micro. Sci. vol. x. p. 7, pl. ii. (January).
(vi.) 1870. *Stelletta agariciformis*, O. Schmidt, Atl. Sp. F. p. . pl. vi. f. 12 (May).
(vii.) 1870. *Dorvillia agariciformis*, Kent, Month. Micros. Journ. p. 293, pl. lxvi. (December).
(viii.) 1871. *Dorvillia agariciformis*, Kent, Ann. & Mag. Nat. Hist. vol. vii. p. 37.
(ix.) ? *Thenea Wallichii*, P. Wright, Zool. Rec. 1870.
(x.) 1872. *Tethya muricata*, Bwk. Proc. Zool. Soc. p. 115, pl. v. figs. 1–6.
(xi.) 1872. *Tethya agariciformis*, Kent, Ann. & Mag. Nat. Hist. vol. x. p. 209.
(xii.) 1873. *Tisiphonia agariciformis*, Kent, W. Thomson, The Depths of the Sea, pp. 74, 167, fig. 7.
(xiii.) 1878. *Tethea muricata*, Bwk., Carter, Ann. & Mag. Nat. Hist. vol. ii. p. 174.
(xiv.) 1880. *Tisiphonia*, W. Thomson, Carter, Ann. & Mag. Nat. Hist.
(xv.) 1880. *Tisiphonia agariciformis*, O. Schmidt, Spong. d. M. v. Mexico.

The nomenclature of this interesting sponge is marked by misfortune more than falls to the common lot. Since it was first described twelve years ago, it has received no less than six different generic and three specific names, has been identified with species generically different from it, and placed in families of strange kin, only to be expelled as an intruder. Its history is bound up with that of another but closely allied species, *Tethea muricata*, with which, as it obtained earlier notice than *Thenea Wallichii*, we shall commence our account. Bowerbank (i.) mentions *T. muricata* as a MS. name in 1858, when describing and figuring its characteristic spinispirules or "elongated stellates," as he termed these flesh-spicules; in 1862 (ii.) he again refers to it, this time adding a figure of its dermal membrane, crowded with spinispirules and reduced to a net-like appearance by the abundant presence of pore-openings; he likewise mentions the presence of bifurcate-ternate spicules with remarkably long and acute rays, which help to form the skeleton-fasciculi, and lie with their heads expanded beneath the skin. The amount of information which Bowerbank thus incidentally accords us of this MS. species is considerable; and it would be a nice point to determine how far, after his published figures and description, it could be regarded as a merely MS. name; into that question I have fortunately no need to enter. That *T. muricata* differs in a marked manner from other described species of *Tethya* is, however, already quite clear; and Gray (iii.), who had a real knowledge of the sponge, so clearly perceived this as to make it the type of a new genus, which he named *Thenea*, and thus defined:—

Fam. 3. TETHYADÆ.

THENEA. Sponge massive.
Spicules :—1. Simple, not protruded beyond the surface.
2. Large, furcate, ternate, with expanded long acute rays.
3. Elongate, stellate, projecting beyond the surface.

Thenea muricata, Bwk. *ib.* i. pp. 25, 108, figs. 35, 304, 305. Norway, Vigten Isl.

In this definition I recognize as correct the statement that the sponge possesses acerate and bifurcate-ternate spicules and elongate stellates—a collocation of forms so different from that which obtains in any other sponge known in Gray's time as to make the generic distinction founded on it a matter beyond dispute. Moreover, lest it should be objected that the genus rests on a MS. species, I would submit first that Gray, by thus bringing together Bowerbank's scattered references and figures, and by adding thereto, as further information, the presence of acerate spicules, did virtually raise *Thenea muricata* from the rank of a MS. to that of a described species; and next, if this be not admitted as a matter beyond question, that there is no reason why, upon occasion, a genus should not be defined before a species. If the particular information which would enable us to define a species be not forthcoming, while the general characters which are available for generic distinction lie ready to hand, there can be no reason, beyond a superstitious adherence to custom (not recognized convention), which shall prevent us making good use of them. *Thenea*, therefore, is a well-grounded generic title applicable to all such sponges as possess a spicular complement like that defined in this connexion by Gray.

Gray's definition is not unmixed truth; thus, we know now, in direct contradiction to Gray's statements, that the sponge is not massive, that some of the acerate spicules do project beyond the surfaee, and that the spinispirules do not*. Serious as these errors undoubtedl, re, they are in no way fatal;

* Or do so only in dried specimens as a consequence of shrinking.

they render it necessary to amend the definition, but furnish no excuse for expunging the name of the genus. If every badly-defined genus were liable to a change of name, systematic zoologists might as well abandon the task of nomenclature altogether.

In 1869, Sir Wyville Thomson (iv.), in his fine memoir on *Holtenia Carpenteri*, founded a new suborder, "Leptophlœa," with *Tisiphonia*, MS., cited as an example. What *Tisiphonia* might exactly be, there was nothing given to show; the name stands as a word of so many letters, and nothing more. We shall find, however, subsequently that an unfounded attempt was made later to turn it into something more; but to this we shall refer in due course: we proceed now to the direct subject of this communication, *Thenea Wallichii* itself.

In 1870, Professor Perceval Wright (v.) gave a full and faithful account of a beautiful little sponge which had been obtained by Dr. Wallich from a depth of 1913 fathoms. This sponge he named, with happy appropriateness, *Wyville-Thomsonia Wallichii*, thus associating the names of the two preeminent deep-sea investigators with the first-obtained species of deep-sea sponge. It possesses the acerates, bifurcate-ternate spicules and spinispirules of *Thenea*, together with large grapnels and some curious few-rayed (one to eight) stellates, not mentioned in Gray's definition. One would thus naturally be led to include it with *Thenea*, were it not for the two forms last mentioned; and we have now to consider whether these afford sufficient reason for generic distinction. If we refer to the value placed on the presence or absence of grapnels in *Geodia* and *Stelletta*, we shall find that they never serve for more than specific distinction; moreover, if it be allowable to go beyond Gray's definition and consult the actual specimen of *Thenea muricata*, we shall find that grapnels are not wanting in it. Then there only remain the pauciradiate stellates; and these alone will not by any one be considered sufficient to distinguish as different genera species which resemble each other in every other important character. Thus, unless some considerable undiscovered difference exists between *Wyville-Thomsonia Wallichii* and *Thenea muricata*, we must be content to regard the former as a fellow species with the latter, and so to name it, as Professor Wright (ix.) himself now asserts it should be named, *Thenea Wallichii*.

Three months after Professor Wright's paper appeared, Oscar Schmidt partly described a similar sponge obtained from a depth of 178 fathoms off Florida; he figured some of its spicules, the grapnels and spinispirules, and named it *Stelletta agariciformis*. A *Stelletta* it certainly is not, as it lacks the cortex which is essential to that genus; on the other hand, it agrees fundamentally with *Thenea*, and may be called, at this stage of our argument, *Thenea agariciformis*.

Again in 1870, December of that year, Mr. Saville Kent (vii.) described quite independently a sponge in all respects identical with that mentioned and labelled by O. Schmidt. Kent's description is good and fully illustrated, perhaps a little too fully, as he includes certain extraneous sexradiate spicules as proper to the sponge, an error which he was the first to correct (viii.). Kent named his sponge *Dorvillia agariciformis*, choosing, by a quite accidental coincidence, the same character for specific designation as Schmidt had done previously. According to the fortune which seems to wait on nomenclature, we might therefore expect the species would turn out to be different; but, notwithstanding, they are certainly the same.

In the note (viii.) which followed his first paper, Kent states that *Thenea Wallichii* is an embryonic form of *T. agariciformis*, a view accepted by Wright and by spongologists generally. Since, however, Wright's figures of the large few-rayed stellates differ somewhat from those given by Kent, it appeared to me that a loophole was left open for error; and I was led therefore to compare the type specimen of *T. Wallichii* * with Kent's figures and with mountings of the usual agaric form. The result is to show, in a most satisfactory manner, that no sort of real difference exists between the two species: *T. agariciformis* is larger and has a well-marked agaric form with a specialized poriferous area, while *T. Wallichii* is of a globular form and without an evidently specialized poriferous area; these trifling differences are unquestionably due to a difference in age. Though young, Professor Wright's specimen is not embryonic—at least no more so than a child of six is, compared with an adult man. It is considerably advanced in growth; for my smallest specimens of young *Thenea Wallichii* measure only 0·0146 inch in diameter, and this is 0·075 inch, or more than five times as large across.

As Wright's species is certainly a good one, and as it takes precedence of Schmidt's by some three months, that of the latter must, by the most fundamental rule of nomenclature, be suppressed; we then have

Wyville-Thomsonia Wallichii, Wright.
Stelletta agariciformis, O. S.
Dorvillia agariciformis, Kent.
} = *Thenea Wallichii*, Wright.

* For the loan of this valuable type my thanks are due and heartily tendered to Mr. C. Stewart and the Council of the Royal Microscopical Society.

We now return to *Thenea muricata*, of which at last, in 1872, Bowerbank (x.) published a full and illustrated description; and so closely in general appearance and in the size and form of its spicules was it found to resemble *Thenea Wallichii*, that Bowerbank declared his conviction that they were one and the same species. His manner of viewing the relations of the two specimens, Kent's and his own, is, however, in the light of further knowledge, somewhat amusing, since he considers Kent's specimen mutilated, the upper portion having, he says, evidently been torn away from the base, causing the part described to assume a form very much like that of an agaric; and he adds that the filiform anchoring appendages have very much the appearance of being some of the skeleton-fasciculi of the sponge drawn out of the basal portion at the time of its mutilation. Kent (xi.), in a "Note on *Tethea muricata*, Bk., and *Dorvillia agariciformis*, Kent," argues against the identification of the two species, resting his case on (1) the agaric form of *Dorvillia* (*Th.*) *Wallichii*, (2) its possession of fascicles of anchoring-spicules, and (3) of quadriradiate flesh-spicules (more correctly pauciradiate stellates). With reference to the first two distinctive characters, I may confess that I do not place great reliance on them: *T. muricata* is not unlike *T. Wallichii* in general form; and the agaric form of the latter is not constant. Some of Mr. Norman's specimens which possess anchoring fascicles and all the spicules proper to the species show no trace of the agaric form; again, the anchoring fascicles, though usual, are not constant. Other of Mr. Norman's specimens with the agaric form and the proper spicular complement of *T. Wallichii* are entirely devoid of anchoring filaments or of any sign of them. The third character cited by Kent is more important: the curious quadriradiate stellates (to be hereafter described) are abundant and characteristic in *T. Wallichii*; and since Bowerbank did not meet Kent's objection by replying that they also occurred in his specimen, we may conclude that they were not present; and hence so far we must admit the specific distinction of *Thenea muricata* and *T. Wallichii*.

In 1873 we again meet with *Tisiphonia*, a passing mention being made of *Tisiphonia agariciformis*, Kent, by Sir Wyville Thomson (xii.) in the 'Depths of the Sea.' The suborder "Leptophlœa" appears to have slipped the memory of its author, as he speaks of the species he had given in its illustration as "that pretty little hemispherical *corticate* form." An excellent illustration of the general form of the species accompanies this notice.

In 1878 Carter (xiii.) published a "Note on *Tethea muri-*

cata," in which, after an examination of specimens, he asserts the identity of *T. muricata* with *T. Wallichii*. The particular grounds on which this statement is made are not given, however, nor is any attempt made to reply to Mr. Kent's objections; so that one could hardly regard the matter as settled; I therefore wrote to Mr. S. O. Ridley, of the British Museum, asking him to favour me by examining the type specimen of *T. muricata*, with a view to determining whether it does possess quadriradiate stellates or not. I have to thank him for a valuable letter in reply, and particularly for the following statement, which I venture to quote:—"I have been carefully through with a high power the seven slides which represent the type specimen of *Tethea muricata*, and find nothing which seems to represent the quadriradiate described and drawn by you in your letter and figured by Wright, of which I have now *seen* specimens by examining our slides of '*Dorvillia agariciformis*,' probably representing the type of that species." After Kent's remarks and this explicit statement I consider that we must regard *T. muricata* and *T. Wallichii* as distinct species. In this connexion it is worth noticing that the quadriradiate stellates are the last spicules to appear in the development of *T. Wallichii*; so that very young examples of this species are not distinguishable from *T. muricata*.

In the "Note," Carter further states that *Normania crassa*, Bk., *Hymeniacidon placentula*, Bk., and *Eccionema compressa*, Bk., are no other than various forms of *T. muricata*. In order to enable me to examine the truth of this surprising statement, Mr. Norman placed in my hands the type specimen of *N. crassa*, together with various other specimens, not types, and *a* type specimen of *H. placentula*. I find that all these specimens, including both supposed species, agree in every essential detail with one another, but that they are generically different from *Thenea*, though otherwise nearly allied to it. This was precisely what Mr. Norman predicted. They are without the bifurcated ternate spicules and the grapnels of *Thenea*, and, on the other hand, possess in abundance a small fusiform roughened acerate which is absent from *Thenea*. Moreover the structure of their dermis is completely different; in *Thenea* it is supported by the long rays of the bifurcated ternates, in *Normania* by horizontal fascicles of large fusiform acerates, with an occasional triradiate or quadriradiate spicule. These differences are sufficient to support the generic distinction of *Normania* and *Thenea*; but that they are closely allied is shown by the similarity in the character of their mesodermic tissue, and by the presence in both of the same form of spinispirula; both likewise are Leptochrotæ.

In 1880 Carter (xiv.) again refers to *T. muricata*, retracting some of his previous statements, as when he admits the specific value of the differences between *T. Wallichii* and *T. muricata*; and he still rightly maintains the specific identity of *N. crassa*, *H. placentula*, and *E. compressa*.

Perhaps the most striking contribution made in this communication to nomenclature is the attempt to impose *Tisiphonia* upon it, the claims of *Thenea*, to say nothing of *Wyville-Thomsonia* and *Dorvillia*, being wholly ignored. *Thenea* has precedence of this MS. name by two years; and *Wyville-Thomsonia* and *Dorvillia* were fully defined and illustrated three years before the first figure of *Tisiphonia*, unaccompanied by generic diagnosis, was published in a popular book.

Finally, Oscar Schmidt (xv.), in a work bearing 1880 as the date, also adopts the name *Tisiphonia*, and relies on its rooting fibres as the characteristic feature by which it is distinguishable from *Stelletta*. If it were possible to establish the genus on this character (and I am confident it is not), the claims of *Tisiphonia* to recognition would not be enhanced thereby, since with *Thenea* out of the way there would still remain *Wyville-Thomsonia* and, perhaps with still stronger claims, *Dorvillia* to be disposed of; and till genera are named by one man's caprice this will not prove an easy task. Again, if my contention so far should fail, then I will put in argument the fact that the name *Tisiphonia* has already been twice preoccupied, once by a butterfly (*Tisiphone*), and again by a reptile (*Tisiphone*), and is therefore unavailable.

But, finally, the generic value attributed by Schmidt to anchoring filaments has no existence in the case in point. Amongst Mr. Norman's sponges there is a specimen of *T. Wallichii*, which in no single feature differs from the ordinary type except in one, that, namely, which Schmidt has come to regard as of generic importance. No naturalist would make a different species of it; and yet it has the misfortune to be without anchoring fibres. The distinction of *Thenea* from *Stelletta* is not trifling; it is sharp and obvious. The spicules of the two are, it is true, similar, except that the former is characterized by a spinispirule in place of a stellate; but this difference is just as useful in classification as that between the globate of *Geodia* and the *Stelletta* stellate. The real difference lies, however, as Sir Wyville Thomson perceived in 1869, in the absence of a crust in *Thenea*, which widely separates it from the *Stelletta* series. Other differences almost as great are also known—the clear gelatinous character of the mesoderm, so different from the grey granular mark of *Stelletta*, for one, and the vesicular character of the water-canal system for another.

General Form.—If we imagine a round or oval tureen, with a conical cover overlapping it at the edges, and the foot produced into a number of descending rootlets, we shall have a good idea of the general form of a symmetrically-grown and adult example of *Thenea Wallichii.* The part corresponding to the cover we shall call the upper half, that to the dish the lower half of the sponge; and the space between them overlapped by the edge of the cover we shall call the "equatorial recess." The upper half is usually conical, with a circular oscule at the apex; near the base it curves over into a convex overlapping edge, which covers, as the edge of a thatched roof does the eaves, the rounded annular inflection which we term the equatorial recess. The lower half, which is usually either more or less hemispherical or conical, is produced into a number of descending conical processes, from each of which issues a root as a single fibre, which afterwards frays out into a white woolly-looking tuft by the separation of its component spicules. Variations, greater or less, from the general form are very numerous: the equatorial recess, which in the most symmetrical forms extends all round the sponge, in others frequently fails to do so, being interrupted at intervals, through which the upper and under surfaces pass insensibly into each other; sometimes it is confined to one quarter of the circumference ot the sponge, or even less; and in one specimen, in every other respect precisely like its fellows, it is entirely absent. The roots vary in number: in the youngest specimens they are never more nor less than one; in the largest of Mr. Norman's specimens there are as many as twenty; on the other hand, in one remarkable specimen of average adult size there are no roots at all, nor any signs of their ever having been present. The roots are liable to be given off from abnormal regions: thus, in a specimen from North America, dredged between Anticosti and Gaspé, they arise from one side of the sponge at a place where the equatorial recess would usually be present, but which has been suppressed here and on the adjacent margin, with a compensating over-development on the side opposite; this arrangement would lead to the sponge being so anchored or rooted that the equatorial recess, which is a special poriferous area, would be the uppermost part of the sponge, while the oscule would lie halfway down the side, looking out laterally. A similar modification occurs in another specimen from the same locality, but with a slight difference, which leads to the oscule being situated on one side of the sponge, and the limited equatorial recess on the opposite side, while the roots descend from what appears to be the base, but which corresponds really to the side of other specimens. These last two specimens may be instances of a local variety, which, however, I shall not dignify by a name, as Schmidt has his *T. fenestrata.* The size of the sponge averages about 1·5 inch in diameter by 1·2 inch in height; the rooting-fibres extend downwards for 0·8 inch usually before fraying out. Mr. Norman's largest specimen measures 3 inches by 2·5 inches in width and breadth, by 1·5 inch in height.

External Surface.—The outer surface of the sponge is felted and thatched by obliquely-projecting, long, slender, acerate, and grapnel-shaped spicules. Round the middle of the upper half, midway between the oscule and the lower edge (tegminal edge we may call it, since it covers or roofs over the equatorial recess), the spicules, lying prostrate almost parallel with the surface, point this way and that, and by their intercrossing form a loosely-felted thicket above the skin—the home of all kinds of animals, Foraminifera (some form of which covers the surface with long strings of sand-grains), Ascidians, worms, and Crustacea. Above this zone the spicules, still projecting obliquely from the skin, point directly towards the apex, so that within a radius of half an inch from it they form a close, regular, but inverted thatch, the free ends of the spicules projecting upwards, and those immediately around the oscule fencing it in with a forest of bristling points. Below the middle zone the spicules proceeding obliquely from the skin point directly downwards towards the tegminal edge, beyond which they project in a fringe of long fine lashes; the thatch is here in the right direction; and the fringe reminds one of the uncut straw hanging over the eaves of a cottage. The lower half of the sponge is covered by obliquely-projecting spicules, showing no regularity in direction, except opposite the tegminal edge; here they point upwards and intercross with the spicules descending from the fringe, forming with them a defensive sieve of great efficiency.

Great variation exists in the distribution and disposition of the spicules as just described; sometimes projecting acerates seem confined to the margin of the oscule and the tegminal edge, or even to the oscular margin alone. Probably in some of these cases the spicules have been lost since the specimen was obtained; in others, on the contrary, they seem never to have been present. Owing to one or other of these causes, *i. e.* abrasion or non-development, or to both, projecting spicules are usually absent over a large part of the skin, the outer surface of which is then clearly exposed to view; it has a greyish tint in spirit-specimens, is often nearly pure white in dried ones. Examining it with a lens, we perceive the thin skin to lie immediately upon the extended rays of bifurcated ternate spicules, which, regularly overlapping, map out the skin into a number of triangular spaces, most of which are singly perforated by a circular pore 0·004 to 0·01 of an inch in diameter. This arrangement is to be seen on both upper and under halves of the sponge; but in the equatorial recess it is replaced by another. There the skin is separated to a greater extent from the mass of the sponge by the underlying vesicles of the canal-system ; it is not supported by the rays of furcate spicules, but fine threads, crossing it transversely, strengthen, support it, and divide it into a number of more or less oval areas, each of which is perforated by a great number of closely-set pores, which reduces it to a fine network (see Kent, xii. pl. lxvi. figs. 3, 4). Of spicules this cribriform floor of the equatorial recess contains chiefly minute spinispirules, and only occasionally quadriradiate stellates.

On cutting the sponge across, one sees a greyish mass enveloped in a thin skin, but without a cortex, traversed by fascicles of spicules and a great number of vesicles; the vesicles lie in rows, longitudinally and radiately disposed.

The Canal-system.—The pores have been already described as distributed generally over the whole surface of the skin, including its conical extensions over the roots of the anchoring fibres. They occupy the triangular spaces in the skin mapped out by the overlapping rays of the furcate spicules below it ; usually there is one pore to each space, rarely two. In the equatorial recess the skin is divided into oval areas by fibrous strings, and in these areas is so abundantly perforated by pores as to be converted into a sieve-like net, in just the same manner as described by Schulze in so many Cerospongiæ, and by myself in *Tetilla*, as likewise occurs in many *Esperiæ*, and probably also in a vast number of other sponges. The curious way in which this cribriform poriferous membrane occurs in a recess, while the rest of the sponge is perforated by single pores, reminds one forcibly of similar arrangements in some of the *Esperiæ*. The pores, whether of the recess or the general surface, lead directly into spherical or ellipsoidal chambers or vesicles beneath the skin, the first of a series of vesicular dilatations which constitute the incurrent canal-system (Pl. XVII. fig. 6). For in this sponge the canals are not canals in the ordinary sense of the word, *i. e.* not continuously open more or less tubular channels, but a succession of vesicles, which seldom open into each other except by narrow sphinctrated orifices. Thus, in a linear series of vesicles representing a canal in other sponges, every vesicle possesses at least two sphinctrated orifices, one putting it in communication with the vesicle behind, and the other with that in front—every vesicle, that is to say, except those beneath the pores; for the pores are not provided with sphincters. The openings into the flagellated chambers are also without sphincters. While two is thus usually the least number of sphincters apparent in a vesicle, a greater number is not uncommon, since, when a lateral series proceeds from a main line, equivalent to the branching of a canal, the first vesicle of the secondary series communicates with that from which it proceeds by a sphinctrate aperture; and thus, as one vesicle of a larger series may bud off, as it were, more than one subsidiary series, it may exhibit four or more sphincters in its walls—two about the communications with vesicles of its own order, and two or more about the communications with vesicles of a lower order. The subsidiary series of vesicles bud off others, and these again others, till the ultimate vesicles are reached which communicate with the flagellated chambers. In this way the size of the vesicles diminishes from 0·015 inch in diameter, which is the average of those in the main series, down to and 0·005 to 0·001, which is that of the ultimate smallest vesicles.

The flagellated chambers (Pl. XVII. fig. 15) are spherical or ellipsoidal sacs communicating by a large circular pore, 0·0032 to 0·006 inch in diameter, with the ultimate incurrent vesicles, and by a wide mouth, from 0·0064 to 0·0096 inch across, with the ultimate excurrent canaliculi. In size they average 0·001 inch in diameter, and thus agree with the similar chambers of the Geodina generally, and of *Tetilla* and such *Esperiæ* as I have examined. This uniformity in size is in striking contrast with the differences which distinguish the chambers of the Chondrosiæ and the Cerospongiæ examined by Schulze, and leads one to suggest that it may result from close genetic relationship.

The excurrent canaliculi lead directly into the nearest vesicle of the excurrent system, about which the flagellated chambers are clustered in a concentric layer (Pl. XVII. fig. 6, *f*). Excepting the canalicular form of its ultimate branches, the excurrent exhibits the same vesicular character as the incurrent system.

The oscule is a more or less circular opening, averaging 0·1 inch in diameter, usually situated in the midst of a gently rising conical eminence; its circular margin is thickened into a lip or annulus of a bluish translucent cartilaginous appearance; and immediately outside this is a surrounding fringe of long acerate spicules. The oscule leads into a wide excurrent canal or oscular tube, transversely constricted by extensions inwards of its walls, but not so completely as to acquire a vesicular character; the mouths of several tributary series of vesicles immediately open into it; and after proceeding for a very short distance downwards, it completely disappears as a tube, and is continued by several vesicular series, into which it subdivides.

Notwithstanding its wonderful transformation, the canal-system is evidently homologous with that of the more normally constituted sponges; the sphincters which invariably occur at the junction of any two vesicles are almost certainly an excessive over-development of the concentric rugæ which characterize the canals of the Geodina and other sponges, and which are more distinctly developed in the smaller branches of the incurrent canals of *Isops Phlegræi* (see *anteà*, vol. v. fig. 1, p. 403). The first incurrent vesicle immediately beneath the skin is situated in tissue characterized by the absence of flagellated chambers, and is clearly homologous with the ectochone of the Corticatæ. The second vesicle, so far as its outer half, is similarly situated; but its inner half is brought into close communication with flagellated chambers; it thus represents an endochone and a subcortical crypt, while the sphincter by which it opens into the first vesicle exactly corresponds to that which we have termed the chonal sphincter.

It is easier to extract homologies from the modifications of the canal-system than to find a use for them. Had the sponge been a coast-dweller, subject to exposure between tides, one might have regarded the vesicles and sphincters as a provision for retaining a supply of water and thus guarding against desiccation. But, so far from this, it is a characteristic deep-sea form, exposed, as one would think, to but few changes of condition.

The vesicular enlargement of the canals certainly gives them a larger capacity and superficial area, with a corresponding diminution of the quantity of tissue in the sponge: the volume of tissue is here at a minimum, of the canal-system at a maximum; thus the advantage is on the side of increased food-supply, while the quantity of tissue to be fed is diminished. Furthermore, not only does the vesicular arrangement permit of a larger quantity of water being present in the sponge at any given moment, but it facilitates a rapid passage of water through it; and, taking this fact along with the abundance of large pores all over the sponge, it would appear as though the most characteristic features of the canal-system were in special adaptation to a free and rapid water-streaming. We might then expect to find the body of the sponge exceedingly well nourished and abounding in protoplasmic structures; and yet, when we come to study its histology, we shall find that it is distinguished, in marked contrast with the Corticatæ, by the small proportion of its protoplasmic contents, the great mass of the sponge consisting of a gelatinous matrix which, whatever its composition may be, is certainly something very different from protoplasm. The rapidity of the water-streaming is therefore probably connected with the poverty in food-particles of the surrounding water, a great deal of water having to pass through the sponge in order to afford it sufficient nourishment.

The sphincters probably act as regulators to the water-streaming, checking it when the water is more than usually burdened with suspended particles, allowing it freer passage when food is scarcer. They might also govern its distribution, closing the passage in some directions, opening it in others, though, in the presumed absence of a combining apparatus such as a nervous system would furnish, this seems unlikely.

In connexion with the "wide-openness" of the canal-system, the small size of the oscule is worthy of note. It seems to point to a rapid escape of the outflowing water, and its consequent ejection to a considerable distance from the inhalant surface. The relative size of the poral and oscular areas in different sponges has never yet been made the subject of investigation, although it differs greatly in different species, and must stand in close connexion with the physiology of the water-streaming system. As a beginning, I have attempted to determine, in the case of this sponge, (i.) the ratio of the poral to the superficial area, and (ii.) the ratio of its total poral area to its total oscular area. In order to make the first determination, a specimen was taken from spirits and allowed to drain till the edges of the open pores just became visible; a part of the surface with its pores was then accurately sketched with the aid of an oblique reflector and under a magnification of thirty diameters. We shall not need to trouble about the absolute size of the pores, as we are only about to determine a ratio. A given area of the drawing was next taken, and the area of the pores in it calculated. I give the results obtained in two instances. In the first—

(i.) The area of the sponge-surface taken from the sketch was 6 square inches.

(ii.) It contained sixteen pores, of which two had a diameter of 0·3 inch, two of 0·25, two of 0·22, eight of 0·2, and two of 0·1.

The total area of these is 0·58216 square inch; and

$$6 : 0·58216 = 1 : 0·097,$$

i. e. 1 square inch of the sponge-surface contains 0·097 square inch of pore-area.

In the second—

(i.) The area of the sponge-surface taken (in the sketch) was 1·5 square inch.

(ii.) It contained twelve pores, two of 0·2, two of 0·15, and eight of 0·1 inch in diameter.

The total area of these is 0·14283 square inch; and

$$1·5 : 0·14283 = 1 : 0·095,$$

a close correspondence for two quite independent determinations, and remarkable considering the difference in the average size of the pores measured in the two cases; it would appear that the smaller pores made up in number for what they lacked in magnitude. Taking the average we obtain 0·096 : 1 as the ratio of the poral to the general area; and the number 0·096 may be called the pore-index of the sponge.

We have next to ascertain the relative size of the total poral to the total oscular area. The specimen on which the preceding observations were made measures 4·084 inches in circumference and 0·8 inch in height; it may be regarded as formed by two equal segments of a sphere 0·9 inch in diameter, each 0·4 inch high, and thus has a superficial area of 2·26 square inches. Multiplying 2·26 by 0·096, the poral index, we have 0·172 square inch as the total poral area; so, if all the pores were to coalesce, they would form a single aperture under one fifth of a square inch in area. This, however, is an underestimate, since no account has been taken of the larger number of pores in the equatorial recess.

The oscule is 0·1 inch in diameter, or 0·007854 square inch in area; and the oscular (O) is consequently to the poral (P) area as

$$0·007854 : 0·172 = 1 : 22.$$

$$\therefore \frac{P}{O} = 22.$$

This number may be conveniently styled the poral-oscular index. Its determination is here probably a little too low; but it suffices to show that, with an almost imperceptible influx of water into the pores of the sponge, there may be a very lively discharge from the oscule. A determination of the value of $\frac{P}{O}$ was made in a second specimen, unfortunately a dried one, so that the results are not trustworthy. The calculation is as follows:—Total area 6·16 square inches, total poral area consequently 0·59136 square inch; area of single oscule 0·0416 square inch; $\frac{P}{O}=\frac{0·59136}{0·0416}=14·2$. The smallness of this number is probably due to the large size of the oscule, consequent on its enlargement by drying.

To ascertain, further, whether any definite relation exists between the general and oscular areas, and consequently between the poral and oscular areas, the largest of Mr. Norman's specimens was examined. In form it approximates to a hemisphere with a radius of 1·4; so that its total area may be taken as 18·475 square inches. It bears six oscules, giving one to every 3·08 square inches of total area.

In the first examined specimen (see *anteà*) we had 2·26 square inches to one small oscule, in the second 6·16 square inches to one large oscule; taking an average from these we have 4·21 square inches to each oscule. Though this is sufficiently greater than the value found from the third specimen to prove that the relation between the general and oscular area is by no means precise, it yet indicates some kind of broad connexion which it may be worth while to further investigate.

The Skeleton.—The large spicules of the skeleton are stout fusiform, and slender filiform, acerates, simple and bifurcated forks, and variously-shaped grapnels. The small spicules are spinispirulæ of two kinds:—(i.) The stout fusiform sharp-pointed acerates are the staple body-spicules; they measure frequently 0·2 inch in length by 0·034 in breadth, and appear sometimes to attain to as much as 0·5 inch in length. (ii.) The long slender acerates, which project beyond the general surface of the sponge, are seldom seen entire, so that it remains doubtful in many cases whether they are truly acerates or only the shafts of grapnel-spicules; they may reach 0·7 to 0·8 inch in length. (iii.) The commonest forks (Kent (vii.), figs. 6, 7) are bifurcated ternates with exceedingly long rays, the primary rays usually measuring about 0·01 inch, and the secondary 0·047 inch in length; the shaft varies greatly, but is often 0·19 to 0·2 inch long; at a short distance below the head it often undergoes a rapid diminution in thickness, becoming almost filiform towards its proximal end, something like a tap-root. (iv.) The forks (*vide* Bwk. (x.), fig. 3) with undivided simple rays are frequent; they are also of very various sizes, 0·27 inch is a not unusual length for the shaft, and 0·034 inch for the rays.

It is not unusual for both kinds of forks to have the rays rounded off at the ends, so that, instead of being long, slender, and pointed, they become short, thick, and stumpy. The proximal end of the shaft is sometimes rounded off in the same way.

(v.) The grapnels (Pl. XVII. fig. 4) are distinguished by their long, sharp, usually straight rays, but there is great variation among them in this and other respects; in one form (fig. 4) the head of the shaft is scarcely at all thickened, and the long rays start with a wide outward sweep from it (at an angle of 55° to 60°) and then somewhat abruptly turn backwards and run more nearly parallel with it, frequently at an angle of 18° to 20°; in another form the shaft thickens towards the head, which is thick and long, and the rays form only short, stout, widely-diverging prongs (Pl. XVII. fig. 14); but there is every intermediate form between these two, and many minor variations surrounding them; in the expansion or not of the shaft below the head, in the size and form of the head, in the length of the rays and the angle they form with the shaft, there is great variety; by far the commonest form, however, is that shown at fig. 4, or some close approach to it. Those grapnels which lie entirely within the body are often 0·1 inch long in the shaft, with rays 0·0082 inch long; those which extend beyond it have not yet been observed entire, but have been measured up to 0·34 inch in length, and probably in the entire state they are sometimes not much shorter than 1 inch.

The development of the grapnels will be described in treating of the young forms of the sponge.

(vi.) A not uncommon variety of large spicule remains to be noticed (Pl. XVII. fig. 3); it resembles the shaft of a ternate spicule, but instead of dividing it thickens club-like at the distal end; in some cases (fig. 17) a protuberance representing a rudimentary ray occurs on one side. These spicules call to mind the club-shaped forms of *Rhaphidotheca Marshall-Halli*, and are either young forms of ternates, or ternates in a state of arrested development, or abnormal forms of the fusiform acerate spicule.

(vii.) The smallest of the minute spicules are the spinispirulæ (Pl. XVII. fig. 24); these consist of a straight or curved shaft, from which spines arise along a spiral course and project radially; the spines are usually sharp-pointed and smooth, but frequently also very finely roughened all over, often with quite abruptly truncated ends. The shaft sometimes becomes very short; and then the spinispirula is scarcely distinguishable from a minute stellate.

(viii.) The larger minute spicule appears to be a spinispirula reduced to a very simple form (*v.* Kent, vii. figs. 16, 17, 18).

It most commonly consists of a very short straight shaft with two long spines radiating from each end, the plane containing the spines at one end being frequently turned at right angles to that containing those at the other, a disposition which suggests a spiral arrangement, not otherwise discoverable in the shaft. Almost as frequently, however, all four spines lie in one and the same plane (*v.* Kent, vii. fig. 18). The number of rays varies greatly: sometimes only two appear, giving us a bent acerate form; often only three, the triradiate so formed closely resembling the characteristic spicule of the Calcispongiæ; four is the commonest number; but additional rays are not uncommonly present, up to and possibly exceeding eight; in instances where the number of rays exceeds five the spiral tendency is more markedly displayed. The shaft sometimes shortens and disappears; and then the four-rayed form resembles the quadriradiate of *Dercitus* (*v.* Kent, vii. fig. 16). The fourth ray often appears as a sprout from one of the rays of a triradiate. The spines are usually sharply pointed, but often become rounded at the ends (fig. 13); they are smooth and only very rarely roughened. In size these spicules vary enormously: the rays of the larger forms are frequently 0·0034 inch long, but they may reach 0·005 or more; in the smaller forms they are often no more than 0·00091 inch long. By multiplying the length of the rays by 2 we get a close approximation to the length of the whole spicule.

The minute spicules are scattered without apparent arrangement through the sponge; the large spicules, on the contrary, lie in fascicles or short fibres, which radiate from the centre to the surface, the rays of the forks spreading out beneath the skin, and the heads of the grapnels lying close beneath them, in the angle between the rays and their shafts. The forks appear never to extend outside the surface of the sponge; but the acerates and the grapnels project a considerable distance beyond it. The proximal ends of these projecting spicules appear about each fibre a little below the skin (Pl. XVII. fig. 6); and the spicules, diverging from each other, pass out in a conical pencil, having its apex pointing inwards. Towards the base one finds in addition numerous spicules converging from the middle of the sponge towards conical papillæ, from which they emerge as single fibres; here the base of the cone is inwards; the fibres afterwards open out to form the terminal tufts of diverging spicules, the greater part of which appear to be grapnels.

The Ectoderm.—The epidermis (Pl. XVII. fig. 32) is a thin membrane everywhere investing the sponge, and bearing immediately on its under surface very definite minute round nucleolated nuclei 0·000125 inch in diameter, each of which is situated in the midst of a cluster of fine granules; it is clearly a layer of pavement-cells from which the cell-outlines have disappeared. Very fine fibrils are usually apparent wandering over its lower surface; they are probably the tenuous ends of branching processes extended from the corpuscles of the underlying connective tissue. The ectoderm is continued inwards as an epithelial lining (Pl. XVII. fig. 47) to the incurrent canals or vesicular system, from no part of which is it absent. In describing the ectoderm of *Tetilla* we stated that the characteristic minute spicules of the sponge (hamates) appear to contribute to its composition; similar components appear also in the ectoderm of *Thenea*. The spinispirules which in this sponge represent the hamates of *Tetilla* are associated, wherever they occur, with a small round nucleus, which lies close to their shaft between two of its spines; when the shaft is curved the nucleus lies in its concavity (Pl. XVII. fig. 24). The nucleus of the spinispirules is undistinguishable in character from that of the ectodermic cells; and in many cases one can see in the epithelium lining a vesicle a nucleus otherwise precisely similar to its fellows, but here embraced by the concave shaft of a spinispirule, and so closely as to show that it belongs to the spicule, which on its part lies so near to the epithelium that its minute spines project through it (Pl. XVII. fig. 47). The nucleus is clearly a part of the epithelium; but likewise it belongs to the spicule; and thus it would appear that the spicule is a genuine component of the epithelium. But spinispirules in association with epithelial and epidermic nuclei are far from uncommon, indeed remarkably frequent; so that we are led to conceive of these membranes as to a considerable extent composed of spicule-bearing cells. Further, as in *Tetilla*, we are brought to the alternative of regarding the ectoderm as a skeletogenous tissue, or of admitting that mesodermic cells may find their way into it and contribute to its formation.

Endoderm.—This lines the excurrent system of vesicles as an epithelium which does not differ from the ectoderm except when it forms the walls of the flagellated chambers. The flagellated cells, in their present state, are rounded or oval bodies 0·000125 inch in diameter, with a well-marked round nucleus containing a nucleolus. They are seated on the walls of the chamber, about 0·00011 inch remote from each other on the average, and number about forty to a chamber. Sometimes one is to be observed markedly larger than the others, 0·00028 inch in diameter; and sometimes a little heap of four small ones is to be seen, as if resulting from the fission of one of the unusually large forms (Pl. XVII. fig. 21).

Mesoderm.—This consists of a gelatinous connective tissue, of which the matrix is a quite colourless transparent jelly, highly unalterable by acids and alkalies, and remarkably poor in granules, those present being exceedingly minute; its corpuscles (Pl. XVII. figs. 25, 29, 30) consist of a variable quantity of granular propoplasm, often vacuolated, and provided with an oval or round nucleus 0·00013 to 0·00017 inch in diameter, within which is a minute nucleolus. The outer protoplasm extends into long branching processes, which terminate in threads, scarcely traceable near their ends for fineness. Sometimes the threads diminish regularly up to their ends; sometimes after diminishing they thicken out up to a point of bifurcation (fig. 30); frequently the angle of the bifurcation is filled up by an accumulation of protoplasm; sometimes, finally, a short process from the corpuscle thickens into a lump of sarcode at the end, from which several short hair-like processes radiate outwards (Pl. XVII. fig. 30). Sometimes the fine ends of the threads appear to terminate freely; more often they unite with those from neighbouring corpuscles. A large proportion of them are elongated in one direction and joined end to end to form long granular nucleated threads (Pl. XVII. fig. 25); the lateral branches proceeding from the protoplasm about the nuclei of the corpuscles unite with similar threads or enter other corpuscles. Sometimes the matrix about the fibre becomes in places finely fibrillated parallel with it (fig. 25, *f*). The ends of the fibres or of the branches from them appear to be ultimately brought into close connexion with the ectodermic and endodermic layers; for on the inner faces of these layers fine filamentous processes are often seen wandering, and the branching filaments of connective-tissue corpuscles can frequently be traced right up to them; in several cases also, I believe, I have seen a connexion between the individual cells of a flagellated chamber and the branching processes of a corpuscle (fig. 15). It is, indeed, difficult while studying this reticulum of connective-tissue corpuscles to resist the idea that we are here dealing with something that plays the part of a nervous system. And just as the nervous tracts usually follow and are protected by the skeletal structures, so here a large number of the corpuscular fibres are seen running parallel close by the side of the chief spicules of the body. On the other hand, the modifications which some of the corpuscles undergo seem inconsistent with special nervous properties.

In an irregularly defined layer a little below the skin, at about the level of the first and second vesicles of the incurrent canal system, the connective-tissue corpuscles have undergone a remarkable internal change (Pl. XVII. fig. 18). Within the granular protoplasm a smooth shining globule makes its appearance; it is colourless, transparent, homogeneous, and highly refringent. In some corpuscles only one such body is present; in others several, lying in close contact with flattened apposed faces. The number in different groups does not follow any regular series, such as 1, 2, 4, 8, &c., but any number may occur from 1 to 8, and perhaps more: nor are the granules of a group all of the same size; there may be one large and several smaller ones of various degrees of minuteness. Sometimes they lie in immediate contact with the protoplasm, more often separated from it, lying in a vacuolated space. We are able fortunately to determine the stage in which they earliest appear, by finding them in evidently very young corpuscles, distinguished by the large quantity of their finely granular protoplasm, which takes a specially deep stain with reagents. From this starting-point we can readily trace their history as they are followed deeper into the interior of the sponge. In corpuscles a stage older than the preceding we find the protoplasm becoming less granular, staining much less deeply with carmine, and diminishing likewise in quantity, so that it forms a mere spherical or oval shell around the granules, but still retaining its outward radiating processes (Pl. XVII. fig. 19); these, however, in the next stage also disappear, and the corpuscle becomes simply a mere oval or spherical sac, filled with the products of its metamorphosis or secretion, amidst which the nucleus lies concealed (Pl. XVII. figs. 26, 45, 46). The shining granules next begin to diminish in number and size, and at length finally disappear, leaving as an effete residuum the investing sacs, which, lined by a small quantity of protoplasm produced sometimes into branched processes and showing the now reexposed nucleus, contribute largely to the histological elements of the gelatinous tissue (Pl. XVII. figs. 31, 44).

The manner in which the fat-like granules make their appearance and their subsequent history seem to point to their being food-reserves of some kind; but of what kind in particular, one cannot safely even conjecture. They stain deeply with carmine, turn brown, and not blue, with iodine (i.), do not dissolve in ether or chloroform (ii.), nor in boiling water (iii.), nor in strong sulphuric acid (iv.); strong acids, indeed, like nitric and sulphuric, seem to have no action upon them in the cold, even after prolonged treatment; iodine does not stain them blue after treatment with sulphuric acid (v.): a 5-per-cent. solution of potash hydrate dissolves them; but the resulting solution does not reduce copper from Fehling's solution (vi.). By (i.) they are proved not to be any common form of starch, by (ii.) not fat, by (iii.) not inulin, by (iv.) not tunicin, by (v.) not cellulose, and by (vi.) not sugar. What they are, not one test indicates; and one is led to think they may be some kind of albuminoid.

Another constituent of the mesoderm is furnished by the muscle-fibres, which occur chiefly as forming the sphincters about the openings of the vesicles (Pl. XVII. fig. 47). They are fusiform bodies prolonged at each end into long slender filaments, 0·0002 inch across where broadest, and 0·014 inch in length, composed of granular protoplasm, which stains deeply with carmine, and is thus rendered very distinct amidst the unstained colourless jelly of the matrix, and containing in the middle a round, or more usually oval, nucleus 0·000148 inch broad, with fluid contents and a minute round nucleolus. Occasionally the body of the fibre exhibits very distinct longitudinal striation. The muscle-fibres lie side by side concentrically arranged, to form the sphincters; the ends of some of those towards the outside of the sphincters escape from them tangentially, and wander into the surrounding matrix, where they appear to become connected with the fine terminations of the connective-tissue corpuscles—a union still further suggestive for the latter bodies of a nervous function.

Fibres similar, but differing in slight details from those of the sphincter, run radiately from its outer margin into the surrounding tissue; these are connective-tissue corpuscles.

Large amœbiform cells with pseudopodium-like processes, gigantic oval nuclei, and included spherical nucleoli are to be seen here and there in the mesoderm (Pl. XVII. fig. 48). They never occur in definite lacunæ, like the similar cells of *Tetilla*. It is probable that they become converted into sperm-balls, like those to be presently mentioned.

Spicule-cells have been already mentioned in connexion with the spinispirules; these little spicules are frequently found with an accumulation of protoplasm about their shafts, which extends as a granular fibre over their spines, and contains a small round nucleus with a nucleolus. The large quadriradiate spinispirules occasionally, but not often, present cases of indubitably associated nuclei. The large body-spicules frequently bear on one side of the shaft a large cell, something like the amœbiform cells noticed above, the granular protoplasm of which extends into a thin film, traceable for greater or less distances along the spicule, just as described in similar cases in *Tetilla* (Ann. & Mag. Nat. Hist. ser. 5, vol. ix. pl. vii. fig. 18).

Sperm-balls (Pl. XVII. fig. 28) are the last constituents of the mesoderm to which we need allude; they are rounded or oval clusters measuring about 0·0071 inch along the minor, and 0·01 inch along the major axis, consisting of a vast number of closely packed spherical bodies of various sizes, from 0·00025 to 0·000057 inch in diameter. These stain deeply with carmine; they present no trace of flagella, and are probably spermatozoa in an unripe state. Immediately surrounding each sperm-ball the gelatinous matrix is very finely fibrillated, and outside this thin fibrillar layer abounds in young abundantly and frequently coarsely granular protoplasmic cells (Pl. XVII. fig. 1), which appear to be connective-tissue corpuscles, with short branches and in a very active state of growth. The large amœbiform cells are also sometimes found close to the sperm-ball. Besides these, abundant fusiform connective-tissue corpuscles radiate from the surrounding tissue towards the sperm-cluster, and penetrate the fibrillar layer which immediately surrounds it. This layer, when seen from the inside by the removal of the sperm-granules, presents the appearance of very fine curved striæ, which wander about in all directions, but exhibit a more or less concentric direction about the ends of the fusiform corpuscles which they surround (Pl. XVII. fig. 16).

Finding such a specialization of the mesoderm about each sperm-ball, one almost expects to find them also characterizing some special region of the body; but this is not the case; they occur as near the top as the bottom of the sponge; and all one can say is that they do not approach nearer the surface than the third vesicle of the incurrent system.

Development.—On the early stages of development I can contribute no information; but Mr. Norman's specimens have furnished me with six very young forms, which differ in several particulars from the adult sponge. All six agree in having a prolately ellipsoidal body provided with a single anchoring fibre; and in none is there any trace of an equatorial recess. This is also absent in Prof. Wright's specimen; but in a little example 0·5 inch broad by 0·4 inch high, with five rootlets, it is perfectly developed, as also are all the other characters of the adult sponge. The length of the body in the smallest specimen (Pl. XVII. fig. 7) is 0·02 inch, in the largest 0·06 inch. The anchoring-fibre is continued through the centre of the body as an axis; and a tuft of spicules projecting from the oscular end seems to be its upward termination. In the larger specimens the tufts of spicules radiating from the oscular region outwards are more numerous than in the smaller; and in the largest a branch from the axis downwards seems to be a second rootlet. The spinispirules do not differ from those of the adult; but the quadriradiate spirules are absent from the two youngest forms.

The slender spicules of the anchoring-fibres, over which the ectoderm extends, are mostly rounded at the distal end (Pl. XVII. fig. 39), like many of the spicules of *R. schœnus*, or the forms which so frequently occur as varieties amongst the pin-shaped acuates. These represent the first stage of the grapnel-spicules, which thus differ from the similar spicules in *Tetilla* by the absence of an initiatory inflation. In the next stage (Pl. XVII. figs. 33–38) these spicules exhibit near the distal end a number of little tubercular excrescences, similar to those which occur as abnormal thickenings on many of the spicules both of the Monaxonidæ and the Tetractinellidæ. In many cases these tubercles take the form of small teeth, often recurved, and varying in number from one to six. They are seldom situated at the extreme end of the spicule, usually a little distance from it. In the larger specimens we find a considerable advance in growth and development; the spicules show a marked increase in size; and though some of these larger forms still present a merely rounded end, others possess in addition from one to three short conical teeth budded off at some little distance before the end (Pl. XVII. figs. 40 to 42). There is still not the slightest trace of any terminal inflation, such as occurs in *Tetilla*-grapnels. The rays arise merely as spines, precisely similar at this stage to the more numerous spines which cover the distal end of the quadriradiate spicules of *Tricentrium muricatum*. We may indeed, on the basis of these observations, regard the rays of these grapnels as highly developed spines, which, at their inception indefinite in number, become subsequently limited to three. The club-shaped spicules, previously mentioned as the probable parents of the forks, have also been observed in these young forms; but no spines have yet been found proceeding from them. The bifurcated forks, however, are in these early stages very small, their rays being 0·006 inch long, while those of the adult are 0·05 inch, or eight times as long.

Classification.—Thenea is evidently a true tetractinellid sponge; but it differs from those hitherto described in this Report by the complete absence of a cortex, and thus is a typical example of our Leptochrota; this character has been noticed long ago by Sir Wyville Thomson, who, in his paper on *Holtenia*, recognized its classificatory value, and founded his suborder Leptophlœa upon it. This suborder is nearly the same as my

Leptochrota—the similarity in names, however, being only what we call accidental, arising really from our both having the same idea to express in a single word. Thomson's sub-order, however, was intended to include monaxonid as well as tetractinellid sponges, and thus, ignoring a distinction which all spongologists are now agreed to regard as fundamental, cannot be maintained. This is not the case with Leptochrota, which is a division of the Tetractinellidæ, not of the heterogeneous group Radiantia; Leptochrota, therefore, escapes anticipation, though by a very narrow chance.

As secondary characters distinguishing *Thenea* we may cite the vesicular character of the canal-system, the superabundance of clear gelatinous matrix in the mesoderm, and the substitution of spinispirules for stellates. As agreements of doubtful value with other sponges, we have the similarity in size of its flagellated chambers with those of the Corticata and such *Esperiæ* as I have examined, and the resemblance of its club-shaped spicules to those of the Esperiad *R. Marshall-Halli.* This latter resemblance I regard as possibly due to homoplasy; but in any case it is eminently suggestive of the manner in which the tetractinellid spicules have been evolved.

Distribution.—Kors Fiord, Norway. Station 13, 200 to 300 fathoms. The following occurrences are also recorded:—Atlantic, 58° 23′ N., 48° 50′ W.; 1913 fms. (*Wright*). *Loc.?* 500 fms. (*Kent*); Florida, 178 fms. (*O. S.*); between Anticosti and Gaspé, 220 fms. (*Whiteaves*). Grey ooze generally (*W. Th.*).

Broadly speaking, therefore, it is known on both sides of the Atlantic, from Norway to Florida, and ranging from 100 to 2000 fathoms in depth. Probably its area will be found to be much more extended than this: there is, indeed, a suggestion of its occurring in the Pacific; for Mr. Norman has placed in my hands a specimen which seems specifically identical with *T. Wallichii*, and which came, according to the assertion of the dealer who sold it, from Cebu.

EXPLANATION OF PLATE XVII.

Thenea Wallichii, P. Wright.

Fig. 1. One of the coarsely granular cells in the connective tissue surrounding a sperm-ball (×500).

Fig. 2. Median longitudinal section through the sponge: *o*, the oscule; *t*, tegminal edge; *e*, equatorial recess (nat. size).

Fig. 3. A variety of acerate spicule, with swollen distal end (probably a precursor of the tetractinellid form) (× 30).

Fig. 4. A grapnel-spicule from the body of the sponge (× 45).
Fig. 5. A fusiform fibre from the outer margin of a sphincter (× 435).
Fig. 6. Section from the skin, a short distance inwards. *a*, first incurrent vesicle (=ectochone); *b*, second incurrent vesicle (=endochone and subcortical crypt); *s*, a sphincter; *c*, excurrent vesicle; *d*, *d*, layer characterized by food-reserve cells; *e*, inner ends of a tuft of spicules projecting from the skin; *f*, flagellated chambers. × 22·5.
Figs. 7–12. Outlines of six young forms of *Thenea* (× about 3).
Fig. 13. Pauciradiate stellate or spinispirule, with the spines rounded at the ends (× 315).
Fig. 14. Head of a form of grapnel-spicule common in the anchoring tails (× 166).
Fig. 15. Flagellated chamber, with a large cell seated, like a flagellated cell, on the wall, but connected by a short process with a fusiform connective-tissue corpuscle: *p*, incurrent pore (× 250).
Fig. 16. The inner face of the wall of a cavity, containing a sperm-ball, showing its fibrillated structure and the ends of the connective-tissue corpuscles which penetrate it (× 250).
Fig. 17. Club-shaped distal end of abnormal acerate, showing a rudimentary spine at one side (× 166).
Fig. 18. A young granular cell, containing a large shining grain of undetermined nature—food-reserve cell (× 500). The series of changes which this kind of cell appears to undergo is represented by figs. 19, 26, 43, 45, 46, 44, 31, in the order here given.
Fig. 19. Food-reserve cell (× 500).
Fig. 20. A young granular spherical cell common in the gelatinous connective tissue, and sometimes apparently forming one of the cells of a flagellated chamber (× 500).
Fig. 21. Part of a flagellated chamber seen in optical section, with a group of three young cells within a common cell-wall (× 500).
Fig. 22. Some of the spherical granular bodies which compose a sperm-ball (× 500).
Fig. 23. A flagellated chamber with a connective-tissue corpuscle ending in fine processes over its wall (× 500).
Fig. 24. Spinispirule with its nucleus (× 500).
Fig. 25. A thread of united connective-tissue corpuscles; at *f*, the gelatinous matrix immediately surrounding a corpuscle shows a fine longitudinal fibrillation (× 333).
Fig. 26. Food-reserve cell containing four granules (× 500).
Fig. 27. Fibrillæ in layer surrounding a sperm-ball, having the appearance of tails radiating from the sperm-granules, indicated by the small circles (× 500).
Fig. 28. A sperm-ball with its surrounding layer of modified gelatinous connective tissue (× 20).
Fig. 29. A branching connective-tissue corpuscle, having one of its fibres continuous with a fusiform cell resembling a muscle-fibre: *v*, vacuole (× 500).
Fig. 30. A connective-tissue corpuscle (× 500).
Fig. 31. A cell from the gelatinous connective tissue, consisting of a thin wall enclosing a large vacuole-like space and a round nucleus (probably an exhausted food-reserve cell) (× 500).
Fig. 32. A small portion of the epidermis seen *en face* (× 500).
Figs. 33–38. Young forms of grapnel-spicules from the roots of the young specimens indicated by figs. 7 and 8 (× 315).
Figs. 39–42. Also young forms of grapnels, from the specimens of figs. 10–12 (× 315).

Fig. 43. Small spherical cell with protoplasmic contents, vacuole, and food-grain (× 500).
Fig. 44. Connective-tissue corpuscle with large vacuole (probably an exhausted food-reserve cell) (× 500).
Figs. 45, 46. Cells with large vacuoles and food-grains (× 500).
Fig. 47. A vesicle of the canal-system, showing the nuclei of its epithelial cells and associated spinispirules: *b b*, edge of the vesicle; *s*, sphincter; *c*, surrounding connective tissue. × 250.
Fig. 48. Large amœbiform cell of the connective tissue (× 333).

L.—*Description of a new Species of* Crastia, *a Lepidopterous Genus belonging to the Family* Euplœinæ. By F. Moore.

Crastia Distantii.

Upperside dark cupreous brown, glossed with olive-green: fore wing with a series of eight or nine white submarginal spots, and a marginal row of small spots, similarly disposed and of the same shape as those in the Malayan *Euplœa Bremeri*, Feld., but somewhat larger; two small spots also on the disk below the upper and middle median veins in some specimens; a short slender sericeous streak between the lower median and submedian in the male: hind wing with two rows of prominent white spots.

Underside greenish olive-brown: fore wing with marginal markings as above; two small spots also on the costa, another spot at the end of the cell, and three on the disk: hind wing with prominent marginal spots; a spot at the end of the cell, and five spots beyond. Expanse $2\frac{6}{8}$ to $3\frac{1}{8}$ inches.

Hab. Sumatra. In coll. F. Moore.

LI.—*Researches on the Nervous System of the Larvæ of Dipterous Insects.* By Prof. Ed. Brandt.

Having received from M. Behling a number of Dipterous larvæ belonging to families which had not been previously examined as to their nervous system, I took the opportunity to dissect them, and with the following results.

I have examined the following:—

Leptidæ: *Leptis*, sp.
Bibionidæ: *Bibio Marci*, L.
—— *Pomonæ*, Fabr.
—— *ferruginatus*, L.
—— *varipes*, Meig.
—— *hortulanus*, L.
—— *laniger*, Meig.